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Diagnostic Accuracy of Thyroid Ultrasound in Evaluation of Thyroid Nodules

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Abstract

Background: Thyroid nodules are a common occurrence in the general population.Ultrasound provides a safe and fast sensitive method for the detection of thyroid nodules, and suspicious features can be used to guide further investigation/management decisions. However, given the financial burden on the health service and unnecessary anxiety for patients, it is unrealistic to biopsy every thyroid nodule to confirm diagnosis .

Aim: This study aimed to develop a rational, cost-effective approach to ordering and interpreting imaging and diagnostic tests in the evaluation of the thyroid nodule.

Methods: this was a cross-sectionalprospective study including all patients presented with thyroid nodules either clinically or incidentally discovered in thyroid clinic of endocrine unit in period between March 2019 to March 2022thyroid function test, thyroid ultrasound andFine needle aspiration cytology (FNAC) was done.

Results: According to TI-RADS classification, 2, 7 and 32 nodules categorized as TI-RADS I, II and III were benign on FNAC with specificity of 100%. Therefore, the estimated decrease in unnecessary FNACs was 63.08%. Meanwhile, all nodules categorized as TI-RADS V (very suspicious) were confirmed to be malignant by FNAC with sensitivity, specificity, PPV and NPV of 100%.

Conclusion: The sonographic features, severe hypo-echogenicity and micro-calcification can be used for diagnosis of malignancy. TI-RADS classification and thyroid cancer were associated; TI-RADS 3 and 2 are the most frequently noted classification of TNs in or study.

Keywords: thyroid nodules; thyroid ultrasound ;FNAC.

Introduction:

In medical practice, thyroid nodules are increasingly common, especially among women. The prevalence of detection among healthy individuals is as high as 50%-60%, but the reported occurrence of cancerous nodules in all thyroid nodules has varied from only 1.6%–12%. (1) Thyroid nodules can arise from various conditions, including benign disorders such as colloid nodule, Hashimoto's thyroiditis, simple or hemorrhagic cyst, follicular adenoma, and subacute thyroiditis. They can also be caused by malignant conditions such as papillary cancer, follicular cancer, Hurthle cell cancer, anaplastic cancer, medullary cancer, thyroid lymphoma, and metastases. (2) Thyroid ultrasound is necessary for those who are suspected or already known to have a nodule. Its purpose is to confirm the presence of a nodule, examine for any additional nodules and cervical

lymph nodes, and evaluate for any questionable sonographic characteristics (3). The subsequent stage in the assessment of a thyroid nodule involves performing a fine needle aspiration (FNA) biopsy, which is considered the most reliable diagnostic test (4).

Methods

This is a prospective cross-sectional study that studied 100 individuals who were diagnosed with a thyroid nodule either by clinical presentation or accidentally identified at the thyroid clinic of the endocrine unit. We conducted the study between March 2019 and March 2022.

All participants in the study had a thorough evaluation of their medical history and physical examination, specifically focusing on identifying risk factors that may indicate the presence of cancer, as well as symptoms and signs of both hypothyroidism and hyperthyroidism and any local discomfort caused by pressure. When examining the thyroid gland, it is important to evaluate its size, consistency, and nodular features, including their size, quantity, location, and consistency. Additionally, the cervical lymph nodes should also be checked. Thyroid function tests, including TSH, Free T3, and Free T4, were performed. Additionally, thyroid antibodies, such as anti-TPO and anti-TG, were tested if necessary. We performed a thyroid ultrasound on all participating patients, assessing several aspects such as the location, margin, shape, echogenic foci, echogenicity, composition, posterior echo, nodule halo sign, and flow grade. After doing a radionuclide thyroid scan/scintigraphy on individuals with a thyroid nodule and low serum TSH levels, which indicate overt or subclinical hyperthyroidism, the next course of action is to ascertain whether the nodule is autonomously operating. A procedure called fine needle aspiration cytology (FNAC) was performed. Both of these inquiries were conducted as necessary.

Statistical analysis: Statistical analysis was done using SPSS version 28 (IBM Co., Armonk, NY, USA). Quantitative data were presented as median and interquartile range (IQR) analyzed among more than two groups using the Kruskal-Wallis test. Categorical data were presented as frequency and percentage, analyzed between two groups using the Chi-square test or Fisher's exact test when appropriate, while analyzing between two methods in the same patients using the McNemarmar test or Wilcoxon Signed Ranks test as appropriate. A -two tailed P value < 0.05 was considered statistically significant.

Results:

This study comprised 100 patients with thyroid nodules, consisting of 15 males and 85 females. The median age of the patients was 43 years, with 31% falling in the 30-40 years age group and 33% falling in the 41-50 years age group. The body mass index (BMI) of the individuals varied between 19.43 and 41.51 kg/m2, with a median value of 28.64 kg/m2. Patients exhibited a consistent rhythm with a median heart rate of 80 beats per minute. 37% of the patients were ex-smokers, while 7% were still smoking. Out of the total number of participants, 19 were diagnosed with diabetes, 14 had hypertension, 21 had dyslipidemia, and 55 and 1 had family history of thyroid illness and cancer, respectively. A total of twenty-three patients were administered medication, while four patients underwent radiation treatment. In terms of lifestyle, the majority of participants (75%) consumed food with an average salt content, while 6% and 19% had a preference for low salt and salty cuisine, respectively. The consumption of seafood was infrequent in almost two-thirds of respondents (70%), occasional in 17%, and frequent in 13%. Thyroid gland enlargement was observed in 77% of the participants during the physical assessment. Furthermore, 56% of patients had nodularity on one side, while 37% displayed nodularity on both sides. Regarding the number of TNs, 49% of patients exhibited a solitary TN, whereas 51% displayed several TNs. The patients under investigation exhibited a median TSH level of 1.6 mIU/L.

Thyroid ultrasound revealed that thyroid nodules (TNs) were the most commonly seen on both sides (42%), with 33% detected on the right lobe and 22% on the left lobe. Regarding echogenicity, 48 patients were found to have both hyperechoic and hypoechoic thyroid nodules. Out of the total number of individuals, 47 had a combination of TNs with mixed composition, while 33 had TNs

with a solid composition. 86 of the participants exhibited thyroid nodules that were broader than they were tall, and all subjects except one had nodules with smooth borders. All of the examined TNs were observed to have a circular shape, which is worth mentioning. 21% of patients had echogenic foci suggestive of macro-calcification, while 10% showed echogenic foci indicative of micro-calcification. On the Doppler ultrasound, 87 thyroid nodules revealed without blood flow and 10 showed blood flow just at the edges. The majority of patients (82%) did not have swollen lymph nodes in the surrounding area, while 18% had benign lymph nodes. The median size of the TNs was 20 mm, with an interquartile range (IQR) between 11 and 28. Based on the TI-RADS classification, the most commonly observed classification of thyroid nodules (TNs) was TI-RADS 3, which indicates a mild suspicion for malignancy, in 42% of the patients. TI-RADS 2, which indicates no suspicion, and TI-RADS 4, which indicates a moderate suspicion for malignancy, were observed in 29% and 21% of the subjects, respectively. The doctor's decision was to schedule follow-up appointments for 54 participants, do fine-needle aspiration cytology (FNAC) on 43 subjects, and conduct a scan on only three subjects.

FNAC was recommended for 64.6% of the 65 patients. Based on the Bethesda classification, 86.2% of patients were categorized as class II, indicating benign nodules. These nodules were further classified as colloid in 72.3% of cases, hyperplastic in 12.3% of cases, Hashimoto in 1.5% of cases, and follicular neoplasm in 6.2% of cases. Additionally, 6.2% of patients were classified as class IV, again indicating benign nodules. On the other hand, 7.7% of patients were classified as class VI, indicating malignant nodules of the papillary type.The doctor's conclusion was to schedule follow-up appointments for 56 patients and to recommend surgery for 9 patients.

In terms of post-TI-RADS practice, 33 patients underwent follow-up (28 with stable conditions and 5 with progressing conditions), 23 underwent unnecessary fine-needle aspiration cytology (FNAC) (3 of whom received a scan prior to FNAC), and 5 underwent complete thyroidectomy (one patient had surgery instead of the scheduled FNAC). Following FNAC, a total of 42 patients underwent a follow-up examination, with 27 showing stationary progress and 15 showing progressive progress. Out of these, 18 patients underwent surgery, with 3 undergoing lobectomy and 15 undergoing complete thyroidectomy. A total of 23 patients had surgery, with 87% of them receiving a complete thyroidectomy and 13% receiving a lobectomy. The procedure was appropriate for 39.1% of the patients. The pathology analysis revealed that 78.3% of the 23 patients had benign nodules, with colloid nodules being present in 56.5% of cases, and hyperplastic, Hashimoto, and follicular adenoma nodules present in 4.3%, 4.3%, and 13% of cases, respectively. Malignant nodules, specifically papillary nodules, were found in 21.7% of patients.

A statistically significant correlation was found between the location and composition of TNs as detected by their number and US ($P<0.001$, 0.001 respectively). Specifically, the proportion of bilateral and mixed TNs was considerably greater in the group with multiple TNs compared to the group with a single TN. There was no statistically significant correlation observed between the amount of thyroid-stimulating hormone (TSH) and the number, kind, and size of thyroid nodules (TNs).

Based on the TI-RADS classification, nodules numbered 2, 7, and 32 were classified as TI-RADS I, II, and III respectively. These nodules were determined to be benign using fine needle aspiration cytology (FNAC), with a specificity of 100%. Hence, the calculated reduction in unneeded FNACs was 63.08%. Furthermore, all nodules classified as TI-RADS V (indicating a high level of suspicion) were verified to be cancerous using fine-needle aspiration cytology (FNAC) with a sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of 100%. Among the sonographic features that were examined, severe hypo echogenicity and micro calcification demonstrated the highest positive predictive values for malignancy (100% and 50% respectively), as shown in table 1 and 2. There was no statistically significant disparity between the

findings of FNAC and pathology in diagnosing TNs, since all benign and malignant nodules identified by FNAC were verified by pathology.

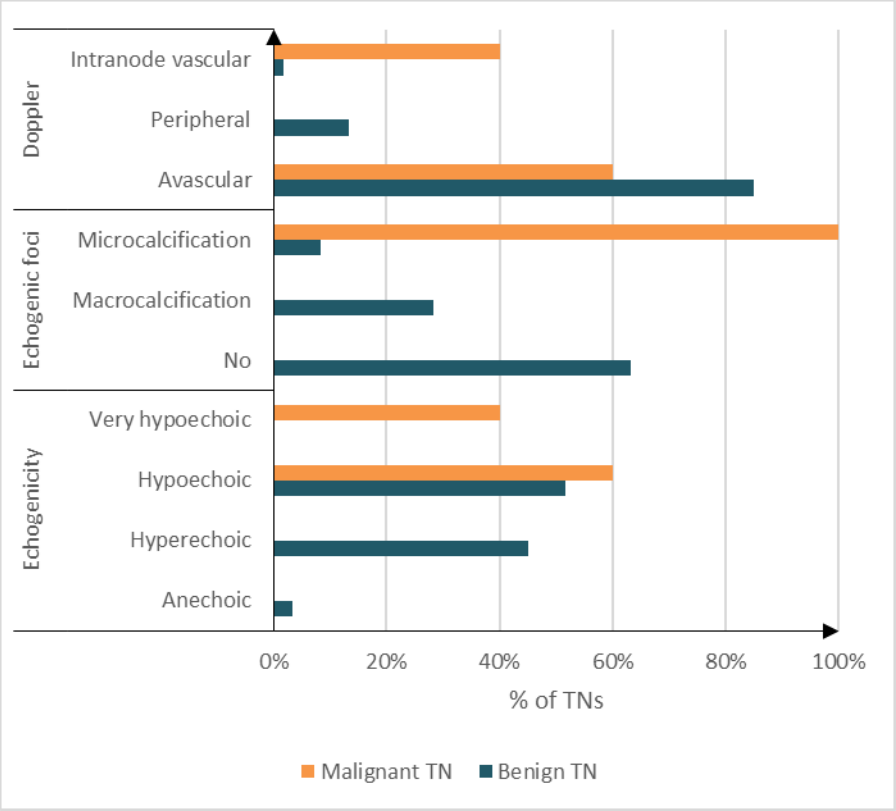


Figure (1): Relation between (echogenicity, calcification and vascularity detected by US) and the type of TNs according to FNAC

Table 1: Diagnostic performance of TI-RADS in comparison to FNAC (n=65)

	Sensitivity	Specificity	PPV	NPV
TI-RADS I	3.33	100	100	7.94
TI-RADS II	11.67	100	100	8.62
TI-RADS III	53.33	100	100	15.15
TI-RADS IV	0	68.33	0	89.13
TI-RADS V	100	100	100	100

PPV: Positive predictive value, NPV: Negative predictive value

Table 2: Diagnostic performance of sonographic features for malignant TNs

		Sensitivity	Specificity	PPV	NPV
Echogenicity	**Anechoic**	0	96.67	0	92.06
	Hyperechoic	0	55	0	86.84
	Hypoechoic	60	48.33	8.82	93.55
	Very hypoechoic	40	100	100	95.24
Composition	**Cystic**	0	95	0	91.94
	Spongiform	0	90	0	91.53
	Mixed	0	51.67	0	86.11
	Solid	100	63.33	18.52	100

Echogenic foci	**No**	0	36.67	0	81.48
	Macro-calcification	0	71.67	0	89.58
	Microcalcification	100	91.67	50	100

PPV: Positive predictive value, NPV: Negative predictive value

A statistically significant correlation was seen between the presence of**family history of** thyroid illness and the type of thyroid nodules, as the group of malignant nodules had a larger percentage of patients with thyroid disease compared to the group of benign nodules (100% vs 45%, P value=0.024).Nevertheless, there was no statistically significant correlation observed between several risk variables, such as sea exposure, patients' age, and sea food consumption, and the number of TNs. An analysis of the data revealed a strong and meaningful relationship between the location and composition of TNs as detected by US, and their quantity. The statistical analysis showed that the proportions of bilateral and mixed TNs were considerably greater in the group with numerous TNs compared to the group with a single TN (P<0.001, 0.001 respectively).

A statistically significant correlation was found between the echogenicity, calcification, and vascularity detected by ultrasound (US) and malignancy (P<0.001). The prevalence of very hypoechoic echogenicity, micro calcification, and intranodal vascularity was significantly higher in the group of malignant thyroid nodules compared to the benign group.

A statistically significant correlation was found between TI-RADS classification and **family history of** thyroid cancer (P=0.001).Having **family history of** thyroid cancer was notably greater in patients classified as TI-RADS V compared to those classified as TI-RADS II, III, and IV.

Table 3: Relation between sonographic features and the type of TNs according to FNAC

		Benign TN (n=60)	**Malignant TN (n=5)**	**P value**
Location	**Rt lobe**	23 (38.3%)	1 (20%)	0.215
	Lt lobe	12 (20%)	2 (40%)	
	Isthmus	2 (3.3%)	1 (20%)	
	Bilateral	23 (38.3%)	1 (20%)	
Echogenicity	**Anechoic**	2 (3.3%)	0 (0%)	**<0.001***
	Hyperechoic	27 (45%)	0 (0%)	
	Hypoechoic	31 (51.7%)	3 (60%)	
	Very hypoechoic	0 (0%)	2 (40%)	
Composition	**Cystic**	3 (5%)	0 (0%)	0.054
	Spongiform	6 (10%)	0 (0%)	
	Mixed	29 (48.3%)	0 (0%)	
	Solid	22 (36.7%)	5 (100%)	
Shape	**Wider than tall**	51 (85%)	4 (80%)	0.579
	Taller than wide	9 (15%)	1 (20%)	
Margins	**Smooth**	60 (100%)	4 (80%)	0.077
	Irregular	0 (0%)	1 (20%)	
Echogenic foci	**No**	38 (63.3%)	0 (0%)	**<0.001***
	Macrocalcification	17 (28.3%)	0 (0%)	
	Microcalcification	5 (8.3%)	5 (100%)	
Doppler	**Avascular**	51 (85%)	3 (60%)	**<0.001***
	Peripheral	8 (13.3%)	0 (0%)	
	Intranode vascular	1 (1.7%)	2 (40%)	

Data are presented as frequency (%), *: Statistically significant as P value<0.05

Table4: Relation between risk factors of patients and TI-RADS classification

		TI-RADS I (n=3)	TI-RADS II (n=29)	TI-RADS III (n=42)	TI-RADS IV (n=21)	TI-RADS V (n=5)	P value
Age (years)	**<30**	0 (0%)	5 (17.2%)	4 (9.5%)	1 (4.8%)	1 (20%)	0.851
	30 – 40	1 (33.3%)	10 (34.5%)	13 (31%)	5 (23.8%)	2 (40%)	
	41 – 50	2 (66.7%)	9 (31%)	14 (33.3%)	8 (38.1%)	0 (0%)	
	51 – 60	0 (0%)	3 (10.3%)	7 (16.7%)	5 (23.8%)	2 (40%)	
	>60	0 (0%)	2 (6.9%)	4 (9.5%)	2 (9.5%)	0 (0%)	
Sex	**Male**	1 (33.3%)	1 (3.4%)	7 (16.7%)	5 (23.8%)	1 (20%)	0.258
	Female	2 (66.7%)	28 (96.6%)	35 (83.3%)	16 (76.2%)	4 (80%)	
Smoking	**Non-smoker**	1 (33.3%)	16 (55.2%)	25 (59.5%)	12 (57.1%)	2 (40%)	0.671
	Former smoker	1 (33.3%)	12 (41.4%)	14 (33.3%)	8 (38.1%)	2 (40%)	
	Current-smoker	1 (33.3%)	1 (3.4%)	3 (7.1%)	1 (4.8%)	1 (20%)	
DM		1 (33.3%)	1 (3.4%)	11 (26.2%)	6 (28.6%)	0 (0%)	0.067
HTN		0 (0%)	1 (3.4%)	8 (19%)	5 (23.8%)	0 (0%)	0.162
Dyslipidemia		1 (33.3%)	2 (6.9%)	11 (26.2%)	7 (33.3%)	0 (0%)	0.104
Thyroid disease		2 (66.7%)	16 (55.2%)	20 (47.6%)	12 (57.1%)	5 (100%)	0.265
Thyroid cancer		0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (20%)	**0.001***
Drug administration		1 (33.3%)	2 (6.9%)	12 (28.6%)	8 (38.1%)	0 (0%)	0.053
Radiation		0 (0%)	0 (0%)	1 (2.4%)	3 (14.3%)	0 (0%)	0.107
Lifestyle							
Taste preference	**Low Salt**	0 (0%)	1 (3.4%)	4 (9.5%)	1 (4.8%)	0 (0%)	0.399
	Average	3 (100%)	25 (86.2%)	31 (73.8%)	13 (61.9%)	3 (60%)	
	Salty	0 (0%)	3 (10.3%)	7 (16.7%)	7 (33.3%)	2 (40%)	
Sea food intake	**Frequent**	0 (0%)	2 (6.9%)	6 (14.3%)	4 (19%)	1 (20%)	0.78
	Occasioned	1 (33.3%)	4 (13.8%)	9 (21.4%)	3 (14.3%)	0 (0%)	
	Infrequent	2 (66.7%)	23 (79.3%)	27 (64.3%)	14 (66.7%)	4 (80%)	

The findings of the linear regression analysis indicate a strong association between the size of thyroid nodules (TNs) and their sonographic properties, specifically their location and composition. The size of thyroid nodules found in the thyroid isthmus was substantially smaller compared to those placed in the right lobe (coefficient = -12.21, 95% confidence interval: -24.18 to -0.25, p = 0.046). Regarding composition, spongiform and mixed TNs were notably lower in size compared to the cystic ones, with coefficients of (-16.53, 95%CI: -26.42 to -6.65, P=0.001) and (-9.34, 95%CI: -18.35 to -0.34, P=0.042) respectively.

Table 5: Simple linear regression analysis for risk factors associated with TNs size

	Coefficient	**95%CI**	**P value**
Age (years)	0.03	-0.14 to 0.21	0.713
Sex			
Male	Ref		
Female	-2.16	-7.8 to 3.47	0.448
BMI	-0.01	-0.51 to 0.49	0.975
Smoking			
Non-smoker	Ref		
Former smoker	-0.27	-4.55 to 4	0.9
Current smoker	3.77	-4.32 to 11.86	0.357
DM	1.13	-4.01 to 6.27	0.664
HTN	2.12	-3.68 to 7.92	0.47
Dyslipidemia	0.1	-4.85 to 5.06	0.967
Thyroid disease	0.25	-3.81 to 4.3	0.904
Thyroid cancer	9.27	-10.92 to 29.46	0.365
Drug administration	0.63	-4.17 to 5.42	0.796
Radiation	0.45	-9.85 to 10.74	0.932
Lifestyle			
Taste preference			
Low Salt	Ref		
Average	1.78	-6.81 to 10.37	0.682
Salty	2.65	-6.83 to 12.13	0.581
Sea food intake			
Frequent	Ref		
Occasioned	-6.43	-13.79 to 0.93	0.086
Infrequent	-3.42	-9.45 to 2.62	0.264
Location			
Rt lobe	Ref		
Lt lobe	-2.35	-7.81 to 3.11	0.395
Isthmus	-12.21	-24.18 to -0.25	**0.046***
Bilateral	-3.59	-8.2 to 1.03	0.126
Echogenicity			
Anechoic	Ref		
Hyperechoic	-6.83	-21.11 to 7.45	0.345
Hypoechoic	-11	-25.28 to 3.28	0.13
Very hypoechoic	-6	-25.79 to 13.79	0.549
Composition			

Cystic	Ref		
Spongiform	-16.53	-26.42 to -6.65	**0.001***
Mixed	-9.34	-18.35 to -0.34	**0.042***
Solid	-8.81	-18 to 0.37	0.06
Shape			
Wider than tall	Ref		
Taller than wide	3.86	-1.9 to 9.62	0.187
Margin			
Smooth	Ref		
Irregular	-0.83	-21.11 to 19.45	0.935
Echogenic foci			
No	Ref		
Macrocalcification	-1.76	-6.78 to 3.26	0.488
Microcalcification	2.9	-3.91 to 9.71	0.401
Doppler			
Avascular	Ref		
Peripheral	-1.45	-8.2 to 5.3	0.67
Intranode vascular	4.16	-7.71 to 16.03	0.489

CI: Confidence interval, *: Statistically significant as P value<0.05

Discussion:

Thyroid ultrasound is necessary for those who are suspected or already known to have a nodule. Its purpose is to confirm the presence of a lesion, check for any other nodules and cervical lymph nodes, and analyze any questionable sonographic findings. The subsequent stage in assessing a thyroid nodule involves conducting a fine needle aspiration (FNA) biopsy, which is considered the most reliable diagnostic test (4). Hence, we conducted this retrospective study with a cross-sectional design to ascertain the presence of both benign and malignant thyroid nodules, as well as their causes. The aim is to provide a logical and cost-efficient method for requesting and analyzingimaging and diagnostic tests when evaluating thyroid nodules.

The findings of our study indicated that as age increases, there is a corresponding increase in the occurrence of thyroid nodules. This observation is consistent with the conclusions drawn by Kwong et al. (5), who found that the prevalence of clinically significant thyroid nodules tends to rise with advancing age, while the likelihood of these nodules being cancerous decreases. However, if thyroid cancer is found in older persons, there is a greater chance of it having a higher-risk histological phenotype. The prior finding indicates that thyroid nodules are more prevalent in females. Farrá et al. (6) found that the majority of patients in their study were women (82%), with an average age at diagnosis is 51 years.

Consistent with our findings, research conducted by OlayiwolaJinadu et al. (7) examined a total of 107 eligible people with thyroid masses who had both ultrasound and fine-needle aspiration cytology (FNAC) of their thyroids for analysis. Out of the total, 91 individuals (85%) were females, and 16 individuals (15%) were males, resulting in a female-to-male ratio of 5.7:1.

The alignment between our research findings on sex and the findings of the referenced publications can be attributed to the potential influence of the combined action of estrogen and progesterone on gender differences. Estrogen affects the thyroid gland and promotes the production of thyrotropin (TSH). Both normal and cancerous thyroid tissues have receptors for estrogen. Therefore, it can be inferred that estrogen may contribute to the proliferation of thyroid cells and the formation of nodules. However, OlayiwolaJinadu et al. (7) disagreed with our findings on age. The participants in

our study were between the ages of 20 and 80. The majority of individuals fell between the age bracket of 41-50 years, with an average age of 46.59 ± 13.55 years.

We evaluated the sonographic characteristics of TNs in our investigation and observed the following findings. The occurrence of TNs was most commonly observed in both sides (42%), with 33% discovered in the right lobe and 22% in the left lobe. Regarding echogenicity, 48 patients were found to have both hyperechoic and hypoechoic thyroid nodules. Out of the total number of individuals, 47 had a combination of different types of TNs, while 33 had TNs that were entirely solid in nature. Out of the total number of participants (98), most of them had thyroid nodules that were wider in shape compared to being tall. Additionally, all subjects except for one had well-defined and even edges.

In the study conducted by Ha et al., (8), out of the 1112 nodules examined, 390 nodules (35.1%) were observed to have echogenic foci, while the remaining 722 nodules (64.9%) did not. Out of the nodules that had echogenic foci, 254 nodules (65.1%) were determined to be malignant. The small bright spots with a specific type of ultrasound artefact called comet-tail artefact had a malignancy rate of 77.8% in nodules that were solid or mostly solid.

Out of the prominent nodules, the solid ones made up the majority (80%). Among them, 57% were hypoechoic, 29% had irregular borders, 28% had microcalcifications, and 9% had a taller > broader feature.

In the study conducted by OlayiwolaJinadu et al., (7), a comparable proportion of calcification types was seen. Specifically, among the 101 (94.4%) patients with thyroid nodules, no calcification was found. Among those who did have calcification, 5 (4.7%) had coarse calcification and 1 (0.9%) had fine calcification.

In the study conducted by OlayiwolaJinadu et al., (7), it was found that 91.6% of the nodules had normal borders, while 8.4% had irregular margins. Additionally, 74.8% of the nodules were round, 23.4% were oval, and 1.9% were irregular in shape. These findings differ from our own.

Furthermore, the echogenicity observed by OlayiwolaJinadu et al., (7) exhibited variations. Specifically, 93.5% of the cases had a mixed echo-texture, 2.8% were hyperechoic, 1.9% were hypoechoic, and another 1.9% were anechoic (cystic).

Based on the TI-RADS classification, the most commonly observed classification of thyroid nodules (TNs) was TI-RADS 3, indicating a mild suspicion for malignancy, in 42% of the individuals. TI-RADS 2, indicating no suspicion, and TI-RADS 4, indicating a moderate suspicion for malignancy, were observed in 29% and 21% of the subjects, respectively. In the study conducted by Germanoa et al. (9), they disagreed with our findings. They found that the most commonly observed classification of thyroid nodules (TNs) was TI-RADS 4 in 53.1% of the individuals. This was followed by TI-RADS 3, 5, and 2, which were observed in 41.4%, 4.8%, and 0.7% of the subjects, respectively.

FNAC was performed on 64.6% of the total 65 patients. Based on the Bethesda classification, 86.2% of patients were classified as class II, indicating benign nodules. These nodules were further categorized as colloid (72.3%), hyperplastic (12.3%), Hashimoto (1.5%), and follicular neoplasm (6.2%). Additionally, 6.2% of patients were classified as class IV, again indicating benign nodules. On the other hand, 7.7% of patients were classified as class VI, indicating malignant nodules, namely Papillary nodules. In the study conducted by Germanoa et al., the Bethesda classification revealed the following distribution among patients category I was observed in 9.7% of patients, category II in 65.5% of patients, category III in 17.9% of patients, category IV in 1.4% of patients, category V in 1.7% of patients, and category VI in 3.8% of patients. In contrast to our findings, Farrá et al. (6) reported that 23% of patients had benign nodules on FNAC, while 23.5% had benign nodules, 9.6% had follicular neoplasm, and 12.8% had questionable malignancy.

Within our study at FNAC, it was determined that 92.3% of the patients exhibited benign characteristics, whereas 7.7% of the patients displayed malignant characteristics. Nevertheless, the study conducted by OlayiwolaJinadu et al. (7) revealed that all 107 nodules examined were determined to be benign using fine-needle aspiration cytology (FNAC).

Based on the FNAC results, it was determined that 56 patients should undergo follow-up and nine patients should undergo surgery.
Regarding the practice following TI-RADS, the number of patients who underwent follow-up decreased from 54 to 30 (with 28 showing no change and 5 showing progression). Additionally, 65 patients underwent fine-needle aspiration cytology (FNAC). Out of the total, 22 individuals were not specified (3 of whom were intended for a scan that was not performed). Additionally, 5 individuals underwent a complete thyroidectomy (one patient was initially scheduled for FNAC but ended up having surgery instead).

The study conducted by Farrá et al. (6) found that the results of 809 patients were consistent with earlier findings. Specifically, 78% of the patients (630 individuals) received complete thyroidectomy, while the remaining 22% (179 individuals) underwent thyroid lobectomy for the purpose of definite diagnosis. In all, 58% (466/809) of patients were diagnosed with thyroid cancer based on the final pathology results.
In our study, we found a significant association between the presence of thyroid disease in patients and the type of thyroid nodules (TNs) as determined by fine-needle aspiration cytology (FNAC). The group of malignant TNs had a higher percentage of patients with thyroid disease compared to the group of benign TNs (100% vs 45%, P value=0.024). The rise in positive predictive value (PPV) may be attributed to the combination of these echogenic foci with different high suspicion categories of TIRADS. However, the presence of echogenic foci in nodules, when paired with a TIRAD category that is not very suspicious, resulted in a drop in positive predictive value (PPV). Therefore, the evaluation of both TIRADS and echogenic foci together is more accurate in predicting malignancy compared to assessing echogenic foci alone, as stated by Ha et al. (8).
The study conducted by Rosario et al. (10) found that there was a substantial variation in the risk of malignancy among the three levels of solid nodules labelled as TR3, TR4, and TR5 in the TI-RADS classification. In this study, we assessed the accuracy of TI-RADS in diagnosing thyroid nodules compared to FNAC. Our findings revealed that among the lesions classified as TI-RADS I, II, and III, 2, 7, and 32 respectively were confirmed to be benign using FNAC. The specificity of TI-RADS in identifying these benign nodules was 100%.
Hence, the projected reduction in superfluous FNACs was 63.08%. Furthermore, all nodules classified as TI-RADS V (indicating a high level of suspicion) were definitively determined to be cancerous using fine-needle aspiration cytology (FNAC) with a sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of 100%. Giovanella et al. (11) demonstrated that hyperfunctioning thyroid nodules have a very high negative predictive value (NPV), which means they are highly unlikely to be malignant.
In addition, we assessed the diagnostic accuracy of sonographic characteristics in identifying malignant thyroid nodules. Among the features examined, severe hypo echogenicity and micro-calcification demonstrated the highest positive predictive values for malignancy, with rates of 100% and 50% respectively.

Conclusion

The sonographic features, severe hypo-echogenicity and micro-calcification can be used for diagnosis of malignancy.TI-RADS classification and thyroid cancer were associated; TI-RADS 3 and 2 are the most frequently noted classification of TNs in or study. TNs location and composition detected by US are correlated with their number.All nodules categorized as TI-RADS V (very suspicious) were confirmed to be malignant by FNAC.

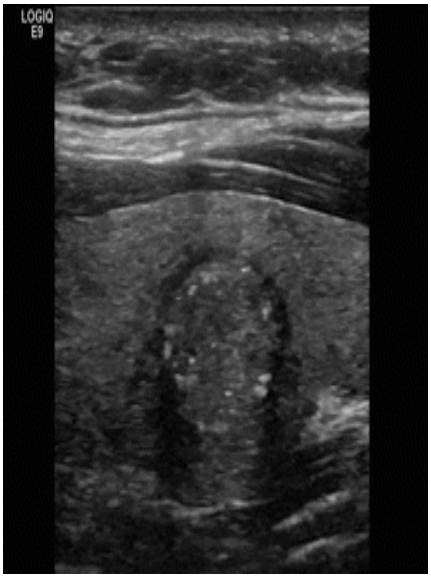
Case 1:

A 57-year-male a family history of thyroid cancer, Rt thyroid nodule

FNAC/ papillary carcinoma, Total thyroidectomy with neck dissection

US / hypoechoic, solid, microcalcifications TIRAD-V

Pathology / papillary carcinoma



A 58-year- female, Rt thyroid nodule
***US/hypoechoic*, solid, macrocalcification,**
TIRAD IV
FNAC / colloid nodule

***Follow-up* stationary course**

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